

REMARKS

Claims 21 (amended) and 22-23 remain in the application along with newly added claims 26-32. Claims 16-20 and 24-25 are cancelled.

Reconsideration is respectfully requested for claims 21 (amended) – 23 and consideration is requested for new claims 26-32.

Claims 21-23 have apparently been rejected under 35 USC § 103(a) as being unpatentable over US Patent No. 6,054,374 to Gardner et al. in view of US Patent No. 5,930,620 to Wristers et al. The Examiner refers to Gardner et al. as allegedly teaching all of the claimed subject matter except for the oxygen implants which is used for enhancing the growth of oxide, the Examiner referring to Wristers et al. as teaching use of an oxide implant to accelerate the growth of an oxide.

The present application is a division of co-pending application serial number 09/449,063 which has method claims. The method claims have been rejected on the cited Wristers et al. patent taken with Hsu et al., 5,480,828 which has teachings similar to the teachings of Gardner et al. in the use of ion implants to vary the growth of silicon oxide in the fabrication of semiconductor devices.

The Board of Appeals has recently handed down a decision on appeal in which the rejection of some claims on Hsu taken with Wristers was upheld and the rejection of other claims directed to a gate dielectric layer including a high dielectric constant dielectric layer and an implanted silicon oxide layer under the high dielectric layer was reversed. Attached is a copy of the Board's Decision on Appeal and the claims on appeal.

Claim 21 has been amended to claim the structure formed by claims 13-15 of the co-pending application, the rejection of which was reversed by the Board of Appeals. Specifically, claim 21 (amended) now specifies a semiconductor device having a gate dielectric of multiple thicknesses for multiple transistors, the semiconductor device comprising:

a first gate dielectric region having a first thickness for a first transistor, and
a second gate dielectric region having a second thickness for a second transistor, the second gate dielectric region including an oxygen-implanted oxide layer under a high dielectric constant layer under a polysilicon gate, the second thickness being greater than the first thickness.

Claims 22-23 and new claims 26-28 depend from claim 21 as amended.

Additionally, new claim 29 specifies a semiconductor device comprising:

a silicon substrate,
a gate dielectric comprising a high dielectric constant layer on the silicon substrate and a silicon oxide layer in the silicon substrate under the high dielectric constant layer, the silicon oxide layer including oxygen ions implanted through the high dielectric constant layer and into the silicon substrate. Claims 30-32 depend from claim 29.

The Board of Appeals found that the method of forming the semiconductor device as defined by claims 21 (amended) and claim 29 (new) and claims depending therefrom was patentable over Hsu taken with the cited Mogami US Patent No. 6,027,977. More particularly, the Board agreed that Mogami teaches doping oxygen into a silicon nitride layer but not through the silicon nitride layer. The objective of Mogami is to create an oxygen-rich layer along an interface between the silicon nitride and the substrate, not an oxygen-implanted region as claimed. The Board noted that Mogami expressly states that the oxygen implantation forms an oxygen-doped silicon nitride film (col. 3, lines 15-19, col. 9, lines 2-5). The objective of Mogami is to prevent boron penetration from the doped polysilicon gate through the silicon nitride dielectric and into the underlying substrate. Thus, Mogami implants oxygen into the silicon nitride layer to provide an oxygen rich region within the silicon nitride film.

A key feature of the invention as presently claimed is the provision of a high dielectric constant dielectric layer which limits subsequent silicon oxide growth from oxygen ions implanted through the silicon nitride layer into the substrate. As noted in Applicant's specification on page 6, a very thin (less than 2 nm) silicon oxide layer can be grown with well controlled thickness. This is not shown or suggested by Mogami, Hsu, or Gardner et al., singly or combined.

For the foregoing reasons, it is requested that claims 21 (amended), 22-23, and 26-32 be allowed and the case advanced to issue.

Should the Examiner have any question or suggestion in view of the present amendment and remarks, a telephone call to the undersigned attorney is requested.

If there are any issues remaining which the Examiner believes could be resolved through either a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned attorney at the telephone number listed below.

Applicant believes that all pending claims are allowable and respectfully requests a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below.

Applicants hereby petition for an extension of time which may be required to maintain the pendency of this case, and any required fee for such extension or any further fee required in connection with the filing of this Amendment is to be charged to Deposit Account No. 500388 (Order No. SRC1P042).

Respectfully submitted,
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